

Polarization-free Cubic Phase GaN Ultraviolet Laser Diodes for Space-based Light Interferometry

Completed Technology Project (2017 - 2021)



Project Introduction

Laser diodes have many advantages over other forms of lasers: extremely compact (<1cm in length), inexpensive and simple designs that can achieve high power, high gain, high modulation speed, high monochromaticity, and excellent reliability and longevity. Aluminum gallium nitride (AlGaIn) is material of choice to emit laser in the ultraviolet range due to its wide bandgap. However, conventional AlGaIn devices are fabricated on III-Nitrides' thermodynamically stable hexagonal phase, which has properties (polarization fields, poor p-doping efficiency, low hole mobility, lack of cleavage planes) that are detrimental to the characteristics of the laser. GaN can also be engineered in its metastable cubic phase that has superior properties (polarization-free, higher hole mobility, higher gain, better p-doping efficiency, cleavage planes) for stimulated emission. My approach of growing cubic phase GaN via metalorganic chemical vapor deposition (MOCVD) on carefully patterned Si(100) mitigates the common issues (phase mixing, defective) found in epitaxy on planar substrates, such as GaAs and 3C-SiC, while adding the benefits of inexpensive substrate, scalability, and the ability to be integrated with Si devices. This proposal opens up a path to polarization-free III-Nitride laser diode devices.

Anticipated Benefits

Laser diodes have many advantages over other forms of lasers: extremely compact (<1cm in length), inexpensive and simple designs that can achieve high power, high gain, high modulation speed, high monochromaticity, and excellent reliability and longevity. This proposal opens up a path to polarization-free III-Nitride laser diode devices.



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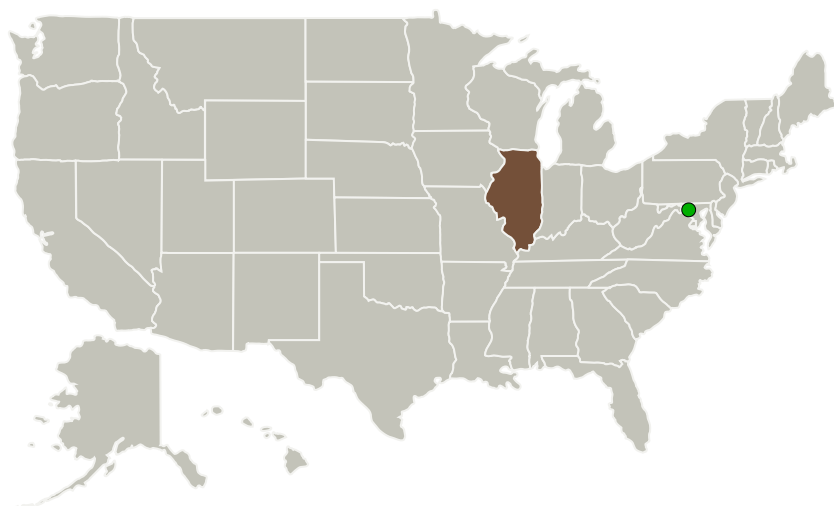
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Illinois at Urbana-Champaign	Lead Organization	Academia	Urbana, Illinois
 Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Illinois

Project Website:

<https://www.nasa.gov/strg#.VQb6T0jJzyE>

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Illinois at Urbana-Champaign

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Can Bayram

Co-Investigator:

Richard Liu

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Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
 - └ TX05.1 Optical Communications
 - └ TX05.1.3 Lasers

Target Destination

Earth